Finite element analysis of three designs of an implant-supported molar crown

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Statement of problem. The optimal method of implant support for a single mandibular molar crown is controversial because commonly used, threaded, root-form implants developed by Branemark were not originally designed to support individual crowns.

Purpose. The purpose of this study was to develop a finite element model of a single mandibular first molar crown supported by (1) a standard 3.75-mm–diameter implant, (2) a 5-mm, wide-diameter implant, and (3) double standard-diameter implants, and to compare the induced displacements as a result of various loading conditions.

Material and methods. Three-dimensional finite element models were made to simulate the 3 single-molar implant designs. Each model was analyzed with 2 force magnitudes (35 N and 70 N) and with 2 force directions (vertical and 15 degrees to the vertical axis). Displacements in 3-dimensional space as a result of the simulated loading conditions were evaluated along 3 primary axes, mesiodistal, faciolingual, and superior-inferior.

Results. Mesiodistal and buccolingual displacements for the crown supported by the 5-mm–diameter implant were reduced by approximately 50% compared with the crown supported by the 3.75-mm implant when the crowns were loaded at the distobuccal cusp tip or the distal marginal ridge. The double-implant design recorded the least mesiodistal displacement with off-center loading of the crown.

Conclusion. When the crown was loaded off-center, the double-implant design produced substantially less displacement when compared with either of the single-implant designs. (J Prosthet Dent 2004;92:434-40.)